Application No. 10/524,551
Applicant: WISMÜLLER, Axel
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Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS:

1. 17. (canceled)

18. (new) A method of processing data for the mapping of input data to output data, the method to be executed on a data processing device and comprising the following steps:

(a) providing data objects to be processed as input data;

(b) processing provided data objects by using a topology-preserving mapping, by:

(i) ordering neurons in ordering space, according to a given pattern;

(ii) assigning codebook objects in outcome space to the neurons;

(iii) processing codebook objects according to the calculation rule of a topology-preserving mapping, by use of data objects of the exploration space; and

(iv) outputting the processed codebook objects as output data;

said method characterized by comprising at least one of the following steps:

(c) determining the order of neurons in the ordering space by using at least a part of the provided data objects, and

(d) providing data objects, which are required for the data processing, which are independent of the input data to be

processed and which are used as data objects of the exploration space.

19. (new) The method of claim 18, wherein the data objects to be processed are distance objects.

20. (new) The method of claim 18,wherein data objects in the ordering space are ordered irregularly.

21. (new) The method of claim 18, wherein data objects of at least one of the ordering space, exploration space, and outcome space are used which comply with at least one of the following conditions:

(A) they satisfy a non-Euclidian geometry;

(B) they are distance objects to data objects of a local neighborhood of data objects;

(C) they represent data distributions with a fractal dimension;

(D) they represent data distributions of non-orientable surfaces in the sense of differential geometry;

(E) they are added, omitted or modified during the training processes or a series of training processes of the topology-preserving mapping, in particular for distance objects in the ordering space;

(F) they are influenced by additional constraints;

(G) they are saved or processed in local units; and

(H) they are added, omitted or modified after completion of the training of the topology-preserving mapping.

22. (new) The method of claim 18, wherein at least one of the calculation rule of the topology-preserving mapping and at least one parameter of this calculation rule:

is chosen depending on the respective processed data object of at least one of the ordering space, exploration space and outcome space;

is modified during the training process or over several training processes of the topology-preserving mapping, in particular depending on the respective processed data object of at least one of the ordering space, exploration space, and outcome space; and

is influenced by additional constraints.

23. (new) A data processing device for carrying out the method of claim 18.

24. (new) A computer program product, which is stored in a memory medium and contains software code segments, configured for carrying out the method of claim 18 if the computer program product is run on a data processing device.

25. (new) A method of processing data for the mapping of data objects to be processed to distance objects, the method to be executed on a data processing device and comprising the following steps:

(a) providing data objects to be processed;

(b) calculating distances between the data objects to be processed as distance objects; and

(c) outputting these distance objects as output data;

said method characterized by the step of:

(d) calculating the distances by use of at least one of statistical learning methods, local models, methods of inferential statistics, and one of the following specific computation methods:

(A) Levenstein Measure;

(B) Mutual Information;

(C) Kullback-Leibler Divergence;

(D) coherence measures employed in signal processing, in particular for biosignals;

(E) LPC cepstral distance;

(F) calculation methods that relate the power spectra of two signals, such as the Itakura-Saito Distance;

(G) the Mahalanobis-Distance; and

(H) calculation methods relating to the phase-synchronization of oscillators.

26. (new) A data processing device for carrying out the method of claim 25.

27. (new) A computer program product, which is stored in a memory medium and contains software code segments, configured for carrying out the method of claim 25 if the computer program product is run on a data processing device.

28. (new) A method of processing data for the determination of the cluster validity, the method to be executed on a data processing device and comprising the following steps:

(a) providing data objects as input data;

(b) providing distance objects between these data objects;

(c) providing an assignment of the data objects to be processed to groups by:

(i) processing provided data objects by using a topology-preserving mapping, by:

(1) ordering neurons in ordering space, according to a given pattern;

(2) assigning codebook objects in outcome space to the neurons;

(3) processing codebook objects according to the calculation rule of a topology-preserving mapping, by use of data objects of the exploration;

(4) outputting the processed codebook objects as output data;

(ii) at least one of the following substeps (1) and (2):

(1) determining the order of neurons in the ordering space by using at least a part of the provided data objects;

(2) providing said data objects that are independent of the input data to be processed and which are used as data objects of the exploration space; and

(d) outputting a measure of the quality of this assignment as output data,

said method characterized by the step of:

(e) calculating the measure of the quality of the assignment by employing at least a part of the provided distance objects.

29. (new) The method of claim 28 wherein step (e) comprises the steps of:

(f) providing data objects to be processed as input data;

(g) processing provided data objects by using a topology-preserving mapping; and

(h) applying a cost function of a method for the clustering of dissimilarity data, wherein the measure of the quality of the assignment is calculated by using at least one set of the set of substeps (h)(i) and h(ii) and the set of substeps (h)(iii)-(h)(vi) and a cost function of a method for the clustering of dissimilarity data:

(i) processing provided dissimilarity data objects by using a topology-preserving mapping, by:

(1) ordering neurons in ordering space, according to a given pattern;

(2) assigning codebook objects in outcome space to the neurons;

(3) processing codebook objects according to the calculation rule of a topology-preserving mapping, by use of data objects of the exploration;

(4) outputting the processed codebook objects as output data;

(ii) at least one of the following substeps (1) and (2):

(1) determining the order of neurons in the ordering space by using at least a part of the provided dissimilarity data objects; and

(2) providing said dissimilarity data objects that are independent of the input data to be processed and which are used as data objects of the exploration space; and

(iii) providing dissimilarity data objects to be processed;

(iv) calculating distances between the dissimilarity data objects to be processed as distance objects;

(v) outputting these distance objects as output data;

(vi) calculating the distances by use of at least one of statistical learning methods, local models, methods of inferential statistics, and one of the following specific computation methods:

(A) Levenstein Measure;

(B) Mutual Information;

(C) Kullback-Leibler Divergence;

(D) coherence measures employed in signal processing, in particular for biosignals;

(E) LPC cepstral distance;

(F) calculation methods that relate the power spectra of two signals, such as the Itakura-Saito Distance;

(G) the Mahalanobis-Distance; and

(II) calculation methods relating to the phase-synchronization of oscillators.

30. (new) The method of claim 28, which is carried out repeatedly, wherein the output data of a previous run of the procedure are entered as input data of a subsequent run of the procedure.

31. (new) The method of claim 28, comprising the step of:

(f) determining the quality of the output data and outputting this determined quality.

32. (new) The method of claim 31 wherein the quality is determined by at least one of:

(A) calculating measures for topology-preservation or distribution-preservation;

(B) calculating distortion measures;

(C) relating the distances of data objects in the ordering space to the distances of corresponding data objects in at least one of the outcome space and the exploration space, in particular by plotting these data objects in a distance plot;

(D) graphically displaying data objects of at least one of the exploration space, the outcome space and the ordering space, in particular by applying these data objects to at least one of an exploration, outcome and ordering plot;

(E) graphically displaying data objects calculated from data objects of at least one of the exploration space, outcome space and ordering space, in particular by plotting these

object data in at least one of an exploration plot, outcome plot and ordering plot;

(F) calculating and outputting the mapping error for at least one of an interpolation, extrapolation, approximation and supervised learning, in particular by forward and backward projection; and

(G) sequential processing of data objects.

33. (new) The method of claim 31, wherein the determined quality is used for at least one of:

(A) adding, omitting or modifying data objects of at least one of the exploration space, the outcome space and the ordering space of the topology-preserving mapping; and

(B) modifying at least one of the calculation rule of the topology-preserving mapping and its parameters, in particular depending on data objects of at least one of the exploration, outcome and ordering space.

34. (new) The method of claim 28 which is used for at least one of the following:

(A) for dimension determination, in particular for the determination of fractal dimensions;

(B) for non-linear embedding, in particular of non-metric data and/or dissimilarity data;

(C) for clustering, in particular of non-metric data and/or dissimilarity data;

(D) for determining the cluster validity, in particular of dissimilarity data and/or non-metric data;

(E) for supervised learning, in particular on non-metric data or dissimilarity data;

(F) for the registration of data sets;

(G) for active learning;

(H) for sorting;

(I) for the optimization, in particular for non-metric data or dissimilarity data;

(J) for finding solutions of Traveling Salesman Problems and equivalent problems, in particular non-metric Traveling Salesman Problems;

(K) for the calculation of hyper-manifolds;

(L) for interpolation, extrapolation, or approximation;

(M) for relevance learning;

(N) for the visualization of graphs;

(O) for graph layout; and

(P) for the construction of self-developing, self-repairing, and/or self-reproducing systems, in particular of technical systems.

35. (new) The method of claim 34 which is used for at least one of the following:

(Q) dimension determination and non-linear embedding;

(R) non-linear embedding and calculation of hyper-manifolds;

(S) clustering and determination of cluster validity; and

(T) non-linear embedding and clustering.

36. (new) The method of claim 34 which is used for at least one of the following:

(Q) the molecular dynamics simulation, in particular where constraints, in particular rigid spatial relations, in the molecule or its surroundings, are modeled as distances of the neurons in the ordering space;

(R) the problem solving in the field of robotics, in particular when constraints, notably rigid special relations, in the robot or its surroundings, are modeled as distances of the neurons in the ordering space; and

(S) data in the fields of economics, finances, medicine, humanities, natural sciences, or technology, in particular in the fields of circuit design, bio-informatics, robotics, meteorology, image processing;

(T) in the field of data-mining, in particular text-mining;

(U) in the field of security technology, specifically flight or access security;

(V) in the field of logistics, in particular traffic control and maintenance systems; and

(W) in the fields of communication technology or cryptology.

37. (new) A data processing device for carrying out the method of claim 28.

38. (new) A computer program product, which is stored in a memory medium and contains software code segments, configured for carrying out the method of claim 28 if the computer program product is run on a data processing device.